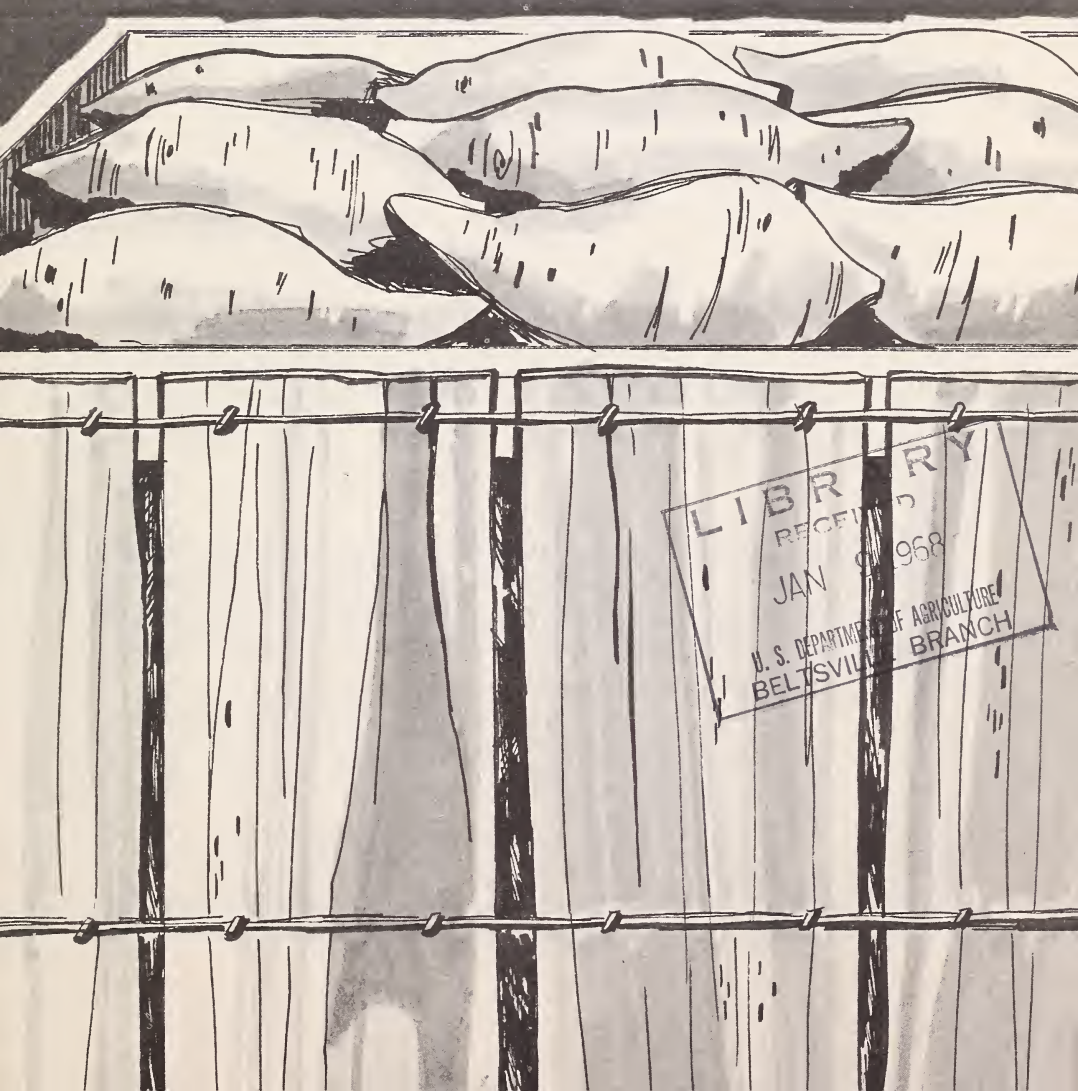
MARKETING BULLETIN NO. 38 / U.S. DEPARTMENT OF AGRICULTURE

PREPARING SWEETPOTATOES FOR MARKET



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Preparing Sweetpotatoes for Market

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Approximately 30 million bushels of sweetpotatoes are produced in the United States each year. Production is confined primarily to 19 states in the southern half of the country. The six states of Georgia, Louisiana, New Jersey, North Carolina, Texas, and Virginia produce about two-thirds of the crop. Each year nearly 20 million bushels of sweetpotatoes go to market for sale as fresh produce in retail stores. The other 10 million bushels are processed and sold as canned, flaked, or frozen products or are used as seed for the next crop.

Sweetpotatoes are dug in late summer and in the fall. Many go to market immediately in a "green" state; the rest are cured and stored for marketing during the winter and early spring following harvest. Preparing sweetpotatoes for market normally includes washing, sorting, and packaging for shipment. They are usually treated to prevent decay, sometimes waxed or colored red, and occasionally graded into sizes other than the customary grades. Because of the large number of items available to the food shopper and the increased importance of attractiveness and convenience, more emphasis is being placed upon suitable methods of preparing sweetpotatoes for the fresh market.

CHARACTERISTICS OF SWEETPOTATOES

Harvesting and handling practices that do not injure the sweetpotatoes are essential. The loss of a small amount of skin is relatively unobjectionable at first. After a few days in transit and in the market, however, these abrasions often appear as sunken, discolored blemishes. Cuts and bruises also detract from appearance. Injuries provide pathways for decay-producing organisms to enter and cause losses.

Injury to sweetpotatoes that have been treated to prevent decay should be avoided. Frequently, packinghouse personnel assume incorrectly that because sweetpotatoes have been treated to prevent decay no further consideration need be given to the development of decay. Even more often, terminal market warehousemen, retail store clerks, and customers are unaware that injuries to sweetpotatoes almost invariably lead to invasion by decay-producing organisms. Packaging and handling practices that discourage or prevent injury to sweetpotatoes should receive careful consideration. Packaging in consumer-size units, for example, will provide some protection. Scarred or decay-

ing sweetpotatoes cause dissatisfied customers as well as monetary loss to retail stores.

To be of good quality and hold up well during marketing, sweetpotatoes should be relatively free of diseases. They should not be damaged by wet or cold soil before harvest or by exposure or chilling after harvest.

Several factors affect the appearance of sweetpotatoes in addition to the loss of skin mentioned above. Most of these are associated with such growing conditions as soil type, soil moisture, presence of nematodes, certain diseases (pox, scurf, blister), and insect damage. Sweetpotatoes cured and stored according to the recommendations in this bulletin are usually more attractive than those cured at lower temperatures or lower relative humidities.

GRADING FOR MARKET

Sweetpotatoes can be washed and graded immediately after they are dug without serious injury during grading. About 48 hours after harvest, however, the skin becomes too loose and comes off too easily to permit grading. It may not "set" well enough to permit grading for several days or until the sweetpotatoes have been cured and stored.

Grading equipment usually includes units for washing, sorting, treating, and packaging. It also may include waxing or coloring units.

Washing

Sweetpotatoes are unloaded on grading equipment by dumping them on a roller conveyor, a rubberized belt, or into a tank of water that has an inclined roller conveyor for removing them; or they may be dumped on a rodlike chute before they are moved onto the roller conveyor or rubberized belt. The chute allows loose soil to fall through but it often causes considerable injury to the sweetpotatoes.

Dumping directly into water, however, eliminates most of the injury. The dump tank must provide for drainage at the bottom to permit flushing out the soil that collects in the tank. The conveyor must be cleaned periodically.

The sweetpotatoes pass under several nozzles that spray water on them while they are scrubbed from below with rollers. The rollers are

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FIGURE 1.—A basket of sweetpotatoes is dumped on a chute of iron rods. Loose soil falls through the rods but the sweetpotatoes usually receive some injuries.

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FIGURE 2.—A box of sweetpotatoes is dumped into a tank of water. Water from the washer flows through the tank and carries away the lightest silt; the tank is drained and flushed periodically to remove soil and other debris that collects in the bottom.

covered with pintle-rubber, Tampico-fiber, or nylon-fiber. The number and type of nozzles and rollers used in the washer depend to some extent upon the kind of soil that sticks to the sweetpotatoes. Small injuries caused by the bristle- or pintle-covered rollers are usually unnoticed immediately after grading, but they usually show up by the time the sweetpotatoes reach the retail stores. Since these injuries detract from the appearance of the sweetpotatoes, the washer should contain no more rollers than necessary.

Washing aids in detecting and sorting out defective sweetpotatoes. This is especially true of defects such as insect injuries or scurf that are difficult to see even on clean sweetpotatoes.

Washing spreads black rot, but the disease may be controlled reasonably well with sodium o-phenylphenate tetrahydrate (SOPP). The grading equipment can be sanitized by spraying it with a 2-percent solution of Vancide 51.[1] After the equipment has been sprayed, it must be washed thoroughly with water to remove all Vancide 51.

Sorting

Although some trash and decayed

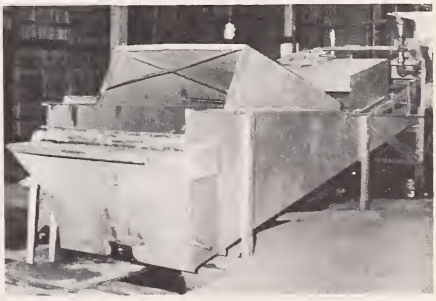

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FIGURE 3.—A dump tank equipped with a hood to prevent splashing nearby workers. A small gate at the bottom (operated by the lever) is used to purge the bottom of the tank and flush away soil that collects.

[1] Water solution of sodium salts of dimethyl dithiocarbamic acid and 2-mercaptobenzothiazole.

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FIGURE 4.—Water is sprayed on sweetpotatoes going through a washer.

sweetpotatoes can be removed before washing, most sorting is done on two conveyors after washing is completed. One conveyor is located after the washer. This is followed by a treating unit and the second conveyor. Culls and sweetpotatoes that are too small or too large for the intended grade are sorted out on the first conveyor. Remaining off-types are removed from the second conveyor after the sweetpotatoes pass through the treating unit.

Sweetpotatoes less than 1¾ inches in diameter usually are sorted out during harvesting and sent directly to canning plants. Those less than 1 inch in diameter are discarded. During the harvest season, any sweetpotatoes less than 1¾ inches in diameter and more than 3 inches in length that reach the grading equipment are also sorted out and sent to the canning plant. Exceptions are small sweetpotatoes of varieties unsuitable for canning such as the Georgia Red. In areas where plants are not available for canning small sweetpotatoes, they may be discarded in the field or during grading. Sometimes sweetpotatoes from 1 to 1¾ inches in diameter are sorted out during grading, later regraded to remove those that are defective, and then packaged into consumer-sized units for marketing.

Sweetpotatoes that are more than 3½ inches in diameter, over 9 inches long, or weigh more than 20 ounces (jumbos) are too large for the U.S. No. 1 grade and are usually removed from the first sorting conveyor. Jumbos may be regraded and sold through markets where such large sweetpotatoes are in demand.

Misshapen, cut, scarred, cracked, and similar defective sweetpotatoes are also removed from the first sorting belt. These are marketed as commercial, U.S. No. 2, or unclassified grades.

In most packinghouses, the sweetpotatoes left at the end of the first sorting conveyor pass through a treating unit and then to the second sorting conveyor where remaining off-types are removed.

Federal grade standards often serve as a guide for packinghouse managers, but the quality requirements of specific market outlets vary so much that sorting usually is done according to the demands of the specific market. In some instances, local or state marketing agreements impose regulations that affect the sorting operation.

Treating

Although every effort is made to prevent injury to sweetpotatoes during grading, it is impossible to avoid all injuries. Decay-producing organisms, especially those that cause soft rot, are likely to enter the sweetpotatoes through such in-

juries. Bruised or crushed tissue offers a particularly favorable place for decay to develop. Most decay is caused by soft rot (Rhizopus sp.). Other diseases such as Fusarium rot, black rot, surface rot, and charcoal rot also cause losses. Marketing losses to sweetpotatoes from 1951 to 1960 are estimated at 19 percent.

Sweetpotatoes showing the presence of black rot at harvest should be graded and sent to market as soon as possible. It is impossible to tell how many sweetpotatoes were infected during harvesting and handling, and curing will not prevent black rot from developing.

Sodium o-phenylphenate tetrahydrate (SOPP or Dowicide A) and 2,6-dichloro-4-nitroaniline (Botran) are approved postharvest treatments to prevent decay during marketing. SOPP is effective against the soft rot and black rot organisms, but Botran is effective only against the soft rot organism. These treatments usually are applied just before the final sorting and packaging. The sweetpotatoes are passed through a tank containing the treating solution or they are sprayed with the solution.

SOPP is applied at concentrations of 0.4 to 0.5 percent to freshly dug sweetpotatoes and at 0.8 to 1.0 percent to those graded after curing. Most stock solutions of liquid SOPP contain 34 percent anhydrous sodium o-phenylphenate. The specific gravity of these stock solu-

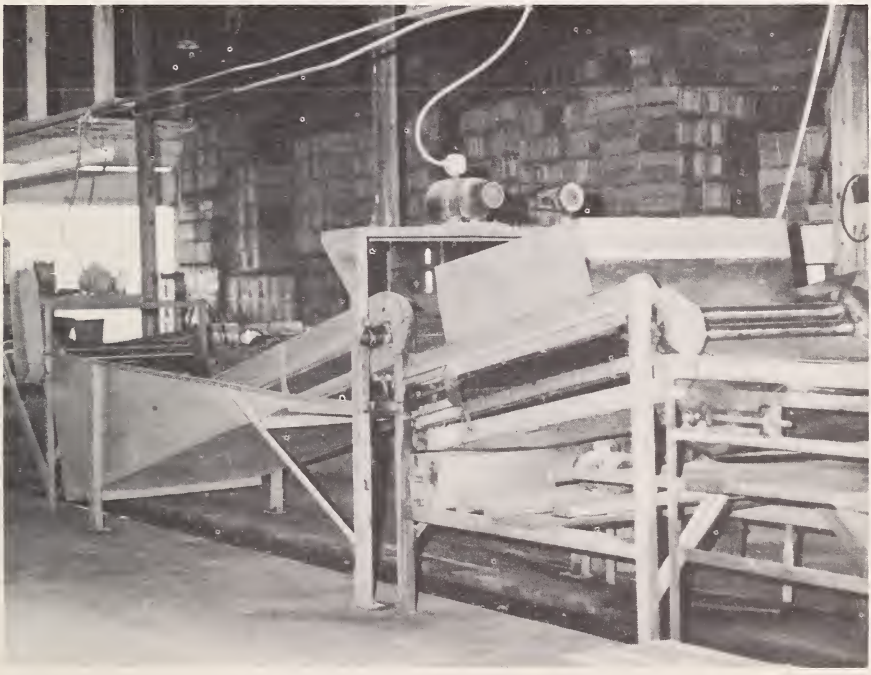

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FIGURE 5.—A dip tank and rinsing (or coloring) unit. Sweetpotatoes are in the treating solution 5 to 10 seconds and drain 15 to 20 seconds on the roller conveyor before going to the rinse or coloring unit in the foreground.

tions is about 1.17, and 1 gallon contains about 4 pounds of SOPP. Therefore, 1 gallon of the stock solution will make 50 gallons of 1.0 percent treating solution.

The concentration of treating solution must be adjusted with use since water on the washed sweetpotatoes dilutes the treating solution. The rate of dilution varies slightly with different kinds of equipment and different surface characteristics of the sweetpotatoes. Usually about 7 gallons of water are carried to the treating solution with each 150 bushels of washed sweetpotatoes.

Tanks containing less than 100 gallons of treating solution are not recommended for SOPP. After 150 bushels of sweetpotatoes have been treated, 1 pint of stock solution (34 percent anhydrous) should be added to maintain 1.0 percent concentration and ½ pint to maintain 0.5 percent. After several such additions the entire solution should be discarded.

To be effective without injuring the sweetpotatoes, the concentration of SOPP must be kept within relatively narrow limits. A test procedure has been developed for checking SOPP solutions. During treatment, the solution should be checked intermittently with a test kit.

Sweetpotatoes treated with SOPP should be rinsed briefly with water or with a water-wax mixture that may or may not include a red dye. An application of hot wax is used in some packinghouses after the sweetpotatoes have been rinsed with water. The rinse is applied to reduce discoloration of skinned areas that may be caused by the SOPP treatment. Because of discoloration, SOPP is not used extensively on freshly dug sweetpotatoes. In some areas it is not recommended for either cured or uncured sweetpotatoes.

Botran is applied as a solution containing 900 parts per million (p.p.m.) active ingredient. Sweetpotatoes may be sprayed with Botran without recirculating the treating solution that drains off the sweetpotatoes. If a 15-gallon tank is used, 1 cup (8-ounce liquid measure that holds about 100 grams of the dry powder) of 50 percent Botran (50W) should be used to charge the tank. After the sweetpotatoes are sprayed, discard the solution that drains from them.

Botran also may be applied in a dip tank. If a 100-gallon tank is used, 1½ pounds of 50W are used initially. After 500 bushels of sweetpotatoes have been treated, ¾ of a pound of 50W is added. This may be repeated once before the tank is drained.

Botran does not discolor sweetpotatoes, so a rinse is not needed after treatment; but water-wax or hot wax may be applied after treatment to improve the appearance of the sweetpotatoes. By adding stock water-wax emulsion and dye to a solution of Botran to get the proper dilution, the sweetpotatoes may be treated, waxed, and dyed with one solution.

Botran solutions may become diluted during treatment to 50 percent of the original 900 p.p.m. concentration and still be effective. Consequently, fewer additions of

Botran during treatment and smaller tanks may be used than with SOPP treating solutions.

Botran is less expensive and easier to use than SOPP and has replaced SOPP in many packinghouses. Do not use Botran 75W formulation (75 percent active ingredient) as it will not maintain a satisfactory suspension without considerable agitation. Even the 50W formulation needs some stirring after the solution has been standing for about an hour.

Instructions, supplied with the treating materials, should be followed carefully to avoid injury to the sweetpotatoes or to people working in the packinghouse, and to comply with the residue requirements of the U.S. Food and Drug Administration. Allowable residues are 15 p.p.m. of o-phenylphenol and 10 p.p.m. of 2,6-dichloro-4-nitroaniline. Shipping containers must be labeled or stamped to indicate plainly that sodium o-phenylphenate or 2,6-dichloro-4-nitroaniline has been applied to the sweetpotatoes.

Waxing

Although the merits of waxing sweetpotatoes have been questioned, waxes are often added in small quantities to improve the appearance of sweetpotatoes. Only wax formulations approved by the Food and Drug Administration may be used. The amount of wax added varies considerably. It may be sprayed on as a water-wax emulsion or brushed on the sweetpotatoes as a warm, thick liquid. Usually, the small amount of wax added is not enough to prevent the sweetpotatoes from drying and losing some weight. Some disease organisms, such as black rot, have been spread by the wax applicators.

Coloring

Red food dyes approved by the Food and Drug Administration may be added to sweetpotatoes to meet the demands of some market outlets. When used, the dyes are usually applied to the sweetpotatoes in water-wax emulsions or hot wax. Some states prohibit the importation of sweetpotatoes to which color has been added. Regulations regarding the use of color change frequently so packinghouse managers should become familiar with current regulations of Federal and State agencies.

Sizing

In a few instances equipment has been installed in the grading equipment to size sweetpotatoes according to their diameters. Although size is considered the most important quality after general appearance, adequate sizing equipment is, unfortunately, not available. Most shoppers prefer sweetpotatoes from 5 to 10 ounces in weight and about 2 to 2½ inches in diameter at the thickest point.

CURING AND STORING

Sweetpotatoes are cured and stored if they are to be graded and sent to market after the harvest season ends. Curing 4 to 7 days at 85° F. and a relative humidity near 90 percent will heal most wounds in-

flicted during harvest. It will also permit satisfactory storage for several months at 55° to 60° F.

Curing and storing changes the taste and texture of sweetpotatoes. Freshly dug sweetpotatoes usually are fairly firm and sweet when cooked. After curing, more of the starch in the sweetpotatoes converts to sugars and dextrins when they are cooked. As a result, cured sweetpotatoes are more moist, softer, and sweeter when cooked than those that are freshly dug. This change is relative; some varieties are typically more moist and sweeter than others. The moist, soft-fleshed varieties such as Porto Rico, Georgia Red, Goldrush, and Centennial are called "yams" even though they are not true yams.[2] Firm, dry-fleshed varieties are represented by Yellow Jersey, Jersey Orange, and Nemagold, although the latter two are sometimes classed as intermediate types.

Sweetpotatoes that are cured usually begin to sprout. If curing is continued or the sweetpotatoes are stored at temperatures above 60° F., the sprouts will continue to grow, especially if the relative humidity is high. When the sprouts grow enough to be noticed, they are objectionable in the market. U.S. No. 1 grade standards permit sprouts no longer than ¾ inch, and many packinghouse managers prefer to remove sprouts even shorter than this to satisfy their trade. Removing the sprouts requires hand labor, so excessive sprouting should be prevented.

PACKAGING FOR MARKET

After the sweetpotatoes have been washed, sorted, and treated, and possibly waxed, dyed, and sized, they must be packaged for shipment to market. Most sweetpotatoes are shipped in wholesale containers that hold about 50 pounds, but occasionally smaller containers are used, including some consumer-size packages that are shipped in master containers.

Wholesale Containers

The use of tub-bottom bushel baskets is declining because they injure the sweetpotatoes more than some other containers and because they are not easily stacked on pallets

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FIGURE 6.—A Hybrid crate used for shipping sweetpotatoes to market. Without the lid and paper strip, this container is used to store sweetpotatoes. A brand and grade label is usually pasted on one end.

[2] The true yam belongs to the genus Dioscorea; sweetpotatoes belong to the genus Ipomoea.

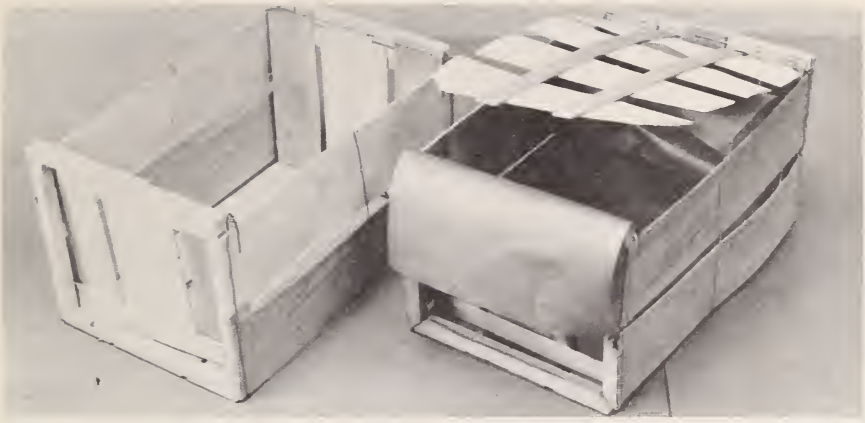

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FIGURE 7.—A 3-way Durabox as used for storage (left) and for shipment to market. A brand and grade label is usually pasted on one end.

or with containers of other produce. Two types of wirebound, rectangular wooden boxes are used extensively: the James or Hybrid crate and the 3-way Durabox. Both of these often are used as storage containers before they are used as shipping containers. Another shipping container that is becoming more popular is one made of fibreboard corrugated cardboard. It has a full telescope lid.

Each of these containers has certain advantages that are important in the overall system of harvesting, storing, and grading used in individual storages and packinghouses. Furthermore, some market outlets often prefer one container over another.

All of the shipping containers provide for some variation in volume because sweetpotatoes vary in specific gravity and, because of size, in packed volume. At harvest, sweetpotatoes usually have a specific gravity of 0.97 to 1.04, but during storage the specific gravity decreases and may become less than 0.85. Large sweetpotatoes usually require more volume in the container than the same weight of small sweetpotatoes from the same lot.

The Hybrid crate has a floating bottom that allows the volume to be decreased by wedging a ¾- to 2-inch board under the bottom. This, plus the bulge in the top, permits the volume to vary by as much

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FIGURE 8.—A corrugated fibreboard box used for shipping sweetpotatoes to market. Brand and grade information usually is printed on all four sides of the lid by the box manufacturer according to arrangements made with the shipper.

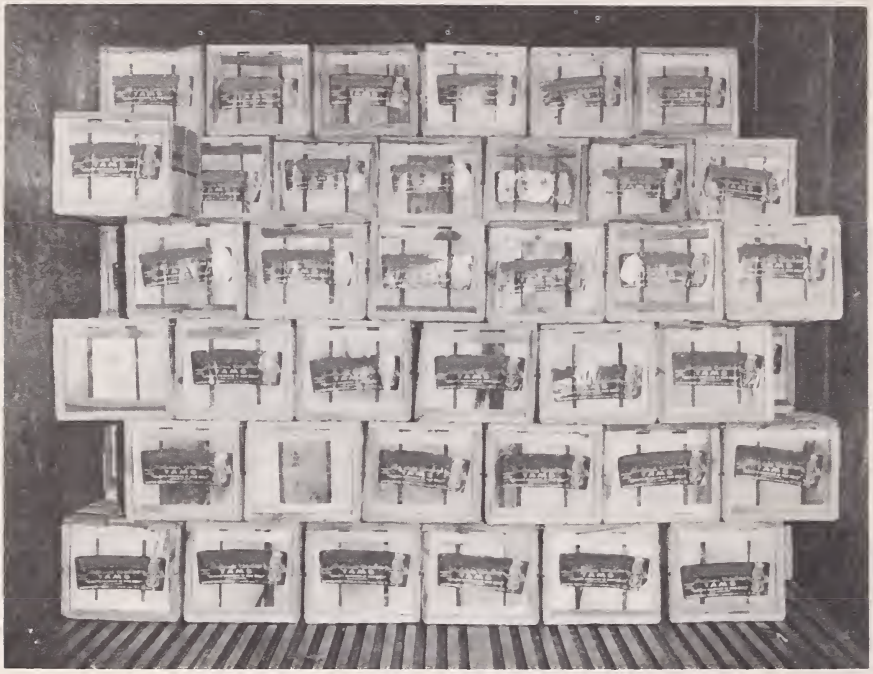

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FIGURE 9.—A truckload of sweetpotatoes packed in 3-way Duraboxes and ready for shipment. The boxes are stacked upright with the ends aligned. This box holds 51 to 52 pounds of sweetpotatoes (50 pounds net) without a bulge in the lid.

as about 300 cubic inches; i.e., from about 2,300 to 2,600 cubic inches. When loaded for shipment, the Hybrid crate is stacked with the bulge on one side so the sweetpotatoes will not be damaged by the containers above.

The 3-way Durabox has a normal capacity of about 2,593 cubic inches. A small bulge may be added in the lid to give a total capacity of about 2,650 cubic inches. Although this container is not as flexible as the Hybrid crate, it can hold 50 pounds of relatively lightweight sweetpotatoes. Heavier sweetpotatoes, such as those at harvest, result in a slack pack. When shipped by truck, the sweetpotatoes are not jostled about too much even when slack, and receivers accept the slack pack as long as proper weight is delivered. This container must be stacked upright and the ends placed in good alignment.

The corrugated fibreboard box has outside dimensions of about 13½ by 18 by 11 inches and a capacity of 2,250 cubic inches. When the telescope lid is raised 1 to 2 inches, the capacity is increased 200 to 400 cubic inches. This, along with some bulging of the sides, provides ample flexibility in volume. The bottom of the box usually is made of 275-pound test fibreboard (Mullen test) and the top is made of 200-pound test fibreboard. Besides the 50-pound box, 40- and 25-pound net weight sizes are sometimes used.

The wooden containers are constructed so that they support the weight of others stacked upon them during shipment and in the market. The sweetpotatoes packed in corrugated, fibreboard boxes support much of the weight of other boxes stacked upon them, but the corrugated material provides some protection for the sweetpotatoes.

The wirebound, wooden, shipping containers weigh approximately 4 pounds each and the fibreboard cartons weigh about 2½ pounds. If the lighter containers are used, as much as 500 to 600 pounds more sweetpotatoes may be shipped in trucks without exceeding highway weight limitations.

Consumer-Size Containers

Treatment of sweetpotatoes to prevent decay has removed the necessity for repacking them in the retail stores and has made packaging in consumer-size units practical. Because of the irregular shape and variable size of sweetpotatoes, equipment to size them for consumer-size packages has been developed slowly. Sizers that are available are not widely used. Therefore, sizing and packaging requires considerable hand labor. This, plus the extra cost of packaging materials, increases the cost noticeably. Nevertheless, packaging in consumer-size units of 2 to 5

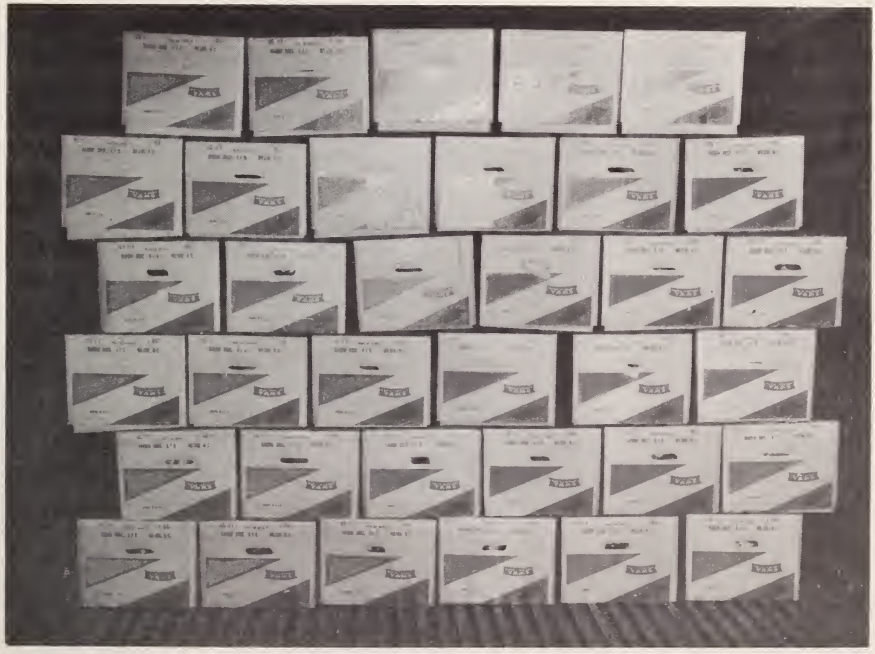

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FIGURE 10.—A truckload of sweetpotatoes packed in corrugated fibreboard boxes. Offset layers are usually alternated and aligned to maintain air channels along the side walls. A special stacking arrangement at the bunker (front) is required to allow air moving through the side-wall channels to enter the bunker and maintain air circulation.

pounds is becoming more popular in some areas.

Sweetpotatoes are packaged in mesh bags, perforated polyethylene bags, or pulp trays overwrapped with stretchable or shrinkable film. The system of merchandising often dictates the type of package used. Mesh bags offer little protection against drying out of the sweetpotatoes. Moisture loss is effectively retarded in polyethylene bags, but the bags occasionally fog over if an insufficient number of perforations are used. Often the consumer-size units are packaged in master containers for shipment to market, but many of the consumer-size units are prepared in the storerooms of the retail stores.

Consumer-size packages are convenient for the retail store customer and give him an opportunity to identify the quality of the sweetpotatoes. Freshly dug sweetpotatoes do not have the same quality when cooked as the same sweetpotatoes after they have been cured. Also, varieties differ considerably in firmness and moistness when they are cooked. In some instances, retail chains and individual shippers supply recipes or cooking suggestions, and they label the consumer-size packages to indicate whether the sweetpotatoes are cured or fresh from the field and moist or dry fleshed. If this can be standardized and generally accepted, it should aid the consumer in buying the kind of sweetpotatoes he prefers.

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FIGURE 11.—Plastic mesh and perforated polyethylene bags of sweetpotatoes in master containers.

BN–30842

FIGURE 12.—Tray packs covered with shrink-film overwrap in one type of master container (cut away to show stacking).

SHIPPING TO MARKET

Nearly all sweetpotatoes are shipped to market by truck or van. Stacking patterns are fairly well established for each type of container. Special provision for air circulation in or around the packages in a load is usually unnecessary with bushel baskets or wirebound crates. But corrugated fibreboard boxes should be stacked to maintain air channels along the side walls and through to the bunker at the front of the truck body so that air can circulate. This is especially necessary in winter months when heat is added to prevent chilling or freezing.

Because of their sensitivity to chilling injury, sweetpotatoes should not be cooled below 55° F. Temperatures from 55° to 70° in transit are recommended. Temperatures above 70° may encourage the growth of decay-producing organisms.

Sweetpotatoes require relatively little ventilation in transit except to control temperature and allow them to dry. A package labeled 50 pounds net is usually packed with 51 or more pounds of wet sweetpotatoes. Loss of weight in transit usually amounts to about 1 pound. Excessive ventilation and drying causes greater weight losses.

During winter months, charcoal or thermostatically controlled alcohol heaters may be placed at the rear or in the bunker of loads going into northern markets. Without

good air circulation, sweetpotatoes near the heaters become too warm while those farther away, especially those on the floor along outside walls, become too cold. In addition to stacking patterns that permit circulation, floor racks that allow the air to pass under the stacked containers are desirable in the coldest weather, along with 2 or more inches of insulation in the walls and ceiling of the van. In transit, the truck driver must periodically inspect the heaters and the temperature of his load. Air circulation should be maintained with a blower, usually mounted in the bunker.

PRECAUTIONS

Fungicides used improperly can be injurious to man and animals. Use them only when needed and handle them with care. Follow the directions and heed all precautions on the labels.

Some States have special restrictions on the use of certain fungicides. Before applying fungicides, check State and local regulations.

Keep fungicides in closed, well-labeled containers in a dry place. Store them where they will not contaminate food or feed, and where children and animals cannot reach them. Promptly dispose of empty fungicide containers; do not use for any other purpose.

When handling a fungicide, wear clean, dry clothing.

Avoid repeated or prolonged contact of fungicide with your skin.

Wear protective clothing and equipment if specified on the container label. Avoid prolonged inhalation of fungicide dusts or mists.

Avoid spilling a fungicide concentrate on your skin, and keep it out of your eyes, nose, and mouth. If you get a concentrate on your skin, wash it off immediately with soap and water. If you spill a concentrate on your clothing, remove the clothing immediately and wash the skin thoroughly. Launder the clothing before wearing it again.

After handling a fungicide, do not eat, drink, or smoke until you have washed your hands and face. Wash any exposed skin immediately after applying a fungicide.

Many fungicides are highly toxic to fish and aquatic animals. Keep fungicides out of all water sources such as ponds, streams, and wells.

Have empty fungicide containers buried at a sanitary land-fill dump, or crush and bury them at least 18 inches deep in a level, isolated place where they will not contaminate water supplies.

You can obtain a list of publications on the subject of preparing sweetpotatoes for market by writing the Market Quality Research Division, Agricultural Research Service, U.S. Department of Agriculture, Federal Center Building, Hyattsville, Md. 20782. Send your request on a postcard. Include your ZIP Code in your return address.

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